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EREMOCORIS DEPRESSUS BARBER: HOSTS, SEASONALITY, AND FIRST NEW ENGLAND RECORDS OF A PINE SEED SPECIALIST (HETEROPTERA: LYGAEIDAE)

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Abstract.—The rhyparochromine lygaeid *Eremocoris depressus* Barber should be considered a characteristic insect of northeastern pitch pine-scrub oak barrens. Known previously only as far north as southeastern Pennsylvania, this rarely collected species is reported from New York and New England (Connecticut, Maine, Massachusetts, New Hampshire, and Rhode Island). Other new records given are District of Columbia, Georgia, Texas, and West Virginia. New hosts recorded for this seed feeder are *Pinus palustris* Mill., *P. pungens* Lamb., *P. rigida* Mill., and *P. taeda* L. Notes on seasonal history and habits of this univoltine seed bug are provided.

Key Words: Insecta, seed bugs, distribution, pine barrens, host specialization

Eremocoris Fieber belongs to the tribe Drymini of the largest lygaeid subfamily, the Rhyparochrominae. Twelve species of this Holarctic genus are known from North America (an additional 9 species occur in Mexico; see Slater and O'Donnell 1995), four of which occur east of the Mississippi: *E. borealis* (Dallas), *E. depressus* Barber, *E. ferus* (Say), and *E. setosus* Blatchley (Ashlock and Slater 1988). *Eremocoris depressus* remains one of the least-studied eastern species of the genus. The adult, illustrated in Hoffman (1996), can be distinguished from its eastern congeners by the flattened body form and the nearly glabrous, uniformly dark (reddish brown to dark castaneous) hemelytra; some specimens are pale beige or bright tan (Slater and Baranowski 1990, Hoffman 1996).

Barber (1928) described *E. depressus* from Louisiana, Mississippi, New Jersey, North Carolina, and Virginia, noting it apparently is a southern species that ranges at least as far north as southern New Jersey. Since the original description, only South Carolina (Rainwater 1941), Florida (MacGowan 1988), and Pennsylvania (Slater and Baranowski 1990) have been cited as new state records. The Pennsylvania record, based on a specimen I collected during the present study (see "Distribution" below), became the northernmost known for the species. Hoffman (1996) provided additional locality records for Virginia. The Missouri record listed in Ashlock and A. Slater (1988) cannot be confirmed (J. A. Slater, personal communication 1992) and may have been cited in error.

For more than 60 years the only biological information available for *E. depressus* was limited to that reported in the original description: an association with Virginia pine (*Pinus virginiana* Mill.) in Virginia and an observation of an adult feeding on squash in Mississippi (Barber 1928). Independently, in Florida and Pennsylvania, its atypical habits were discovered. Instead of feeding on fallen seeds in the litter layer

like most rhyparochromines and nearly all other members of *Eremocoris* (Sweet 1964, 1977), *E. depressus* is arboreal, feeding on mature pine seeds still in the cones (Hoffman 1996). Slater and Baranowski (1990) reported its collection from cones of slash pine (*P. elliottii* Engelm.) in Florida and from pine cones in Pennsylvania. The Pennsylvania record, however, was based only on a single adult from pitch pine (*P. rigida* Mill.) rather than "numbers of specimens" as stated by Slater and Baranowski and clarified by Wheeler (1991a).

Here I give new records for *E. depressus,* extending the known distribution to northern New England. New host records, its occurrence in northeastern pitch pine-scrub oak barrens, and notes on its host plants and seasonal history are provided.

Methods and Study Sites

Most of the new records reported herein were obtained during a study of certain insect groups occurring in northeastern pitch pine-scrub oak barrens, ridgetop pine barrens, and other pitch pine communities (Wheeler 1991b, Wheeler and Wilson 1996). Several of the pine barrens from which *E. depressus* is recorded were described in Wheeler (1991b). Additional locality records are based on specimens in the National Museum of Natural History, Washington, DC (USNM), Pennsylvania Department of Agriculture collection (PADA), and Cornell University Insect Collection (CUIC); further information on the Oglethorpe Co., GA, and Sumter Co., SC, records (cited in brackets) was furnished by G. L. DeBarr (personal communication 1996). The sampling methods used in the Northeast were those described in my earlier study except that cones of pitch pine were emphasized—that is, cones, rather than host branches, were tapped over a shallow insect net.

Information on seasonality of *E. depressus* is based on five collections from pitch pines in the remnant pine barrens near the airport at Concord, NH, as well as on periodic collections from other pitch pine communities in the Northeast. Nymphs dislodged from pine cones were collected, preserved in 70% ethanol, and sorted to instar in the laboratory. Voucher specimens from northeastern pine barrens are deposited in the USNM collection.

Distribution

Present survey.—The following new records (Fig. 1) were obtained during a study of Miridae (Heteroptera) associated with pitch pine (Wheeler, unpublished); all are new state records except Pennsylvania, which was cited by Slater and Baranowski (1990), and New Jersey. Collections were made by the author from pitch pine except in West Virginia, where the host was table mountain pine (*P. pungens* Lamb.). Collections consisting only of nymphs are designated "(N)."

CONNECTICUT: *Windham Co.,* Windham Airport N. of Willimantic, 1 Sept. 1991 (N). MAINE: *Cumberland Co.,* Mayall Rd. N. of Gray, 14 Aug. 1993; *Oxford Co.,* Rt. 5-113 SE. of Fryeburg, 6 July 1991 (N), 19 June 1993; *York Co.,* Ferry Beach State Park nr. Saco, 14 Aug. 1993; Kennebunk Plains, 13 Aug. 1993. MASSACHUSETTS: *Franklin Co.,* Montague sand plains, 15 June (N), 4 July (N), 15 Sept. 1991. NEW HAMPSHIRE: *Carroll Co.,* Ossipee Pine Barrens, 2 June 1995; *Merrimack Co.,* Concord, 5 July (N), 12 Aug., 14 Sept. 1991; 19 June 1993; 2 June 1995. NEW JERSEY: *Ocean Co.,* Rt. 539 S. of Warren Grove, 22 June 1991 (N). NEW YORK: *Albany Co.,* Washington Ave. Ext., Albany, 22 Aug. 1993; *Clinton Co.,* Rt. 87, S. of Plattsburgh, 2 Aug. (N) & 29 Aug. 1992; 13 June 1993; *Saratoga Co.,* Saratoga Co. Airport nr. Ballston Spa, 1 Aug. (N) & 22 Aug. 1992; South Glens Falls, 1 Aug. 1992 (N); *Warren Co.,* Queensbury, Middle School, 30 Aug. 1992. PENNSYLVANIA: *Chester Co.,* Nottingham Co. Park, SW. of Nottingham, 27 Aug. 1988. RHODE ISLAND: *Washington Co.,* gravel pit along Rt. 165 nr. Arcadia Management

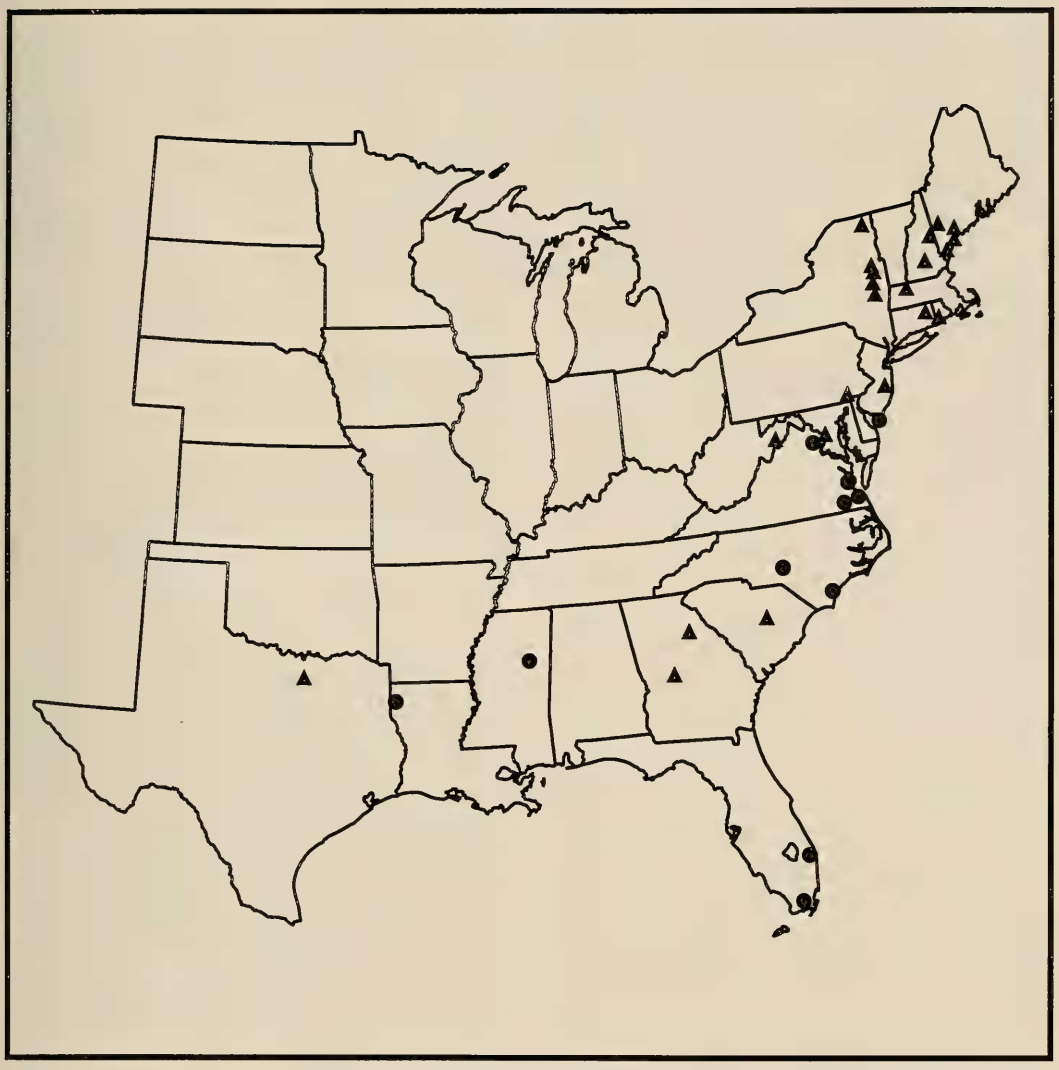

Fig. 1. Known distribution of *Eremocoris depressus*. Triangles= new records from author's surveys (West Virginia to Maine), including a Pennsylvania record published in Slater and Baranowski 1990, and from museum specimens (District of Columbia, Georgia, South Carolina, and Texas); filled circles = previously published records.

Area, N. of Arcadia, 7 July (N), 1 Sept. 1991 (N); 20 June 1993. WEST VIRGINIA: *Hardy Co.,* Lost River State Park Rd., 2.9 mi. N.W. of park, 27 Aug. 1993.

Museum records.—The following unpublished records (Fig. 1) were obtained from specimens housed in the CUIC, PADA, and USNM. Georgia, Texas, and the District of Columbia are new records.

DISTRICT of COLUMBIA: Washington, 10 Aug.; 15 Sept. on pine trees, O. Heidemann; 20 June 1884 (CUIC, USNM). GEORGIA: *Chatham Co.,* nr. Savannah, early Feb. 1983, in fallen *P. palustris* cone, J. R. Steinhauer (PADA); *Oglethorpe Co.* [5 mi. E. of Lexington], 19 May 1977 [ex cones of *P. taeda*], G. L. DeBarr (USNM); [*Peach Co.*] Myrtle, 28 Mar. 1906, on pear, A. A. Girault (USNM). VIRGINIA: [*Arlington Co.*] Rosslyn, 7 Apr. 1895, Chitten-

den (USNM). SOUTH CAROLINA: *Sumter Co.* [S. C. For. Commission seed orchard, nr. Sumter], 30 Sept. 1982 [abundant in cones of *P. taeda*], G. L. DeBarr (USNM). TEXAS: [*Denton Co.*] Denton, 28 May 1906, F. C. Bishop (USNM).

Seasonal History and Habits

Although no adults of *E. depressus* were collected from pitch pines before early June, records of adults from January to early April in the more southern portion of its range indicate that this stage overwinters (Barber 1928, Hoffman 1996, PADA and USNM collections). Adults may hibernate among ground litter, a possibility supported by their collection in "woods trash" during winter (Rainwater 1941), and the adult in February from a fallen longleaf pine cone near Savannah, Ga. (See "Distribution"). It is also possible that some adults overwinter in cones or under bark on host trees.

Overwintered adults were generally present on pitch pines through the end of June in the Northeast. Nymphs were not encountered before mid-June, but the presence of first through third instars at Concord, NH, on 19 June, a second instar in Rhode Island on 20 June, and a fourth instar in the Montague (MA) sand plains on 15 June suggests that eggs hatch at least as early as late May or early June in some inland and coastal pine barrens of New England. Nymphs were always associated with second-year, partially opened cones of pitch pine rather than current-season cones or third-year and older cones that persisted on host trees. My collections were made only from cones within reach of the ground, but observations in Georgia and South Carolina indicate that this lygaeid also lives in cones in the canopy of loblolly pine (G. L. DeBarr, personal communication 1996)

Fourth and fifth instars were collected in northeastern pine barrens by early July, but their development apparently proceeds slowly. Current-season adults were not observed before mid-August; all early August collections consisted entirely of late-instar nymphs, which were sometimes present until late August or early September. Because sampling was limited after mid-September, it is not known how long adults of this apparently univoltine lygaeid remain on host trees.

From southern New Jersey to northern New England, *E. depressus* has been found only on pitch pine. Farther south, it has been collected on loblolly pine, slash pine, table mountain pine, and Virginia pine (Barber 1928, Slater and Baranowski 1990, USNM collection). Its recovery in a pitfall trap in a longleaf pine barren in Virginia (Hoffman 1996) and a fallen longleaf pine cone in Georgia (PADA collection) suggest that *P. palustris* Mill. also serves as a host plant.

Discussion

Originally described as a southern species (Barber 1928) and subsequently considered to exhibit a southeastern (Sweet 1977) or a lower Austral range (Hoffman 1996), *E. depressus* can now be added to the New England fauna. An arboreal habit almost certainly accounts for its having gone undetected in Sweet's (1964) thorough survey of the New England rhyparochromine fauna; his collecting was restricted to the "cryptic ground level biotope." In Sweet's analysis of lygaeid distribution patterns, *E. depressus* roughly corresponds to a type 2 Austral range. Known from southwestern Maine, it ranges south, mainly along the coastal plain, to Florida, and west along the Gulf Coast to Louisiana and eastern Texas (see Fig. 1). The northernmost collection site is just south of Plattsburgh, N.Y. It was found at elevations ranging from near sea level at Maine's Ferry Beach State Park to about 853 m (2800 ft.) on a ridgetop in West Virginia.

In the Northeast, *E. depressus* is a characteristic, though usually uncommon, inhabitant of different types of pine barrens communities. In Maine, it has been found on a pitch pine near the lowland and ridgetop pine barrens at Fryeburg and in the

largely remnant pitch pine-scrub oak barrens in the Kennebunk Plains. This lygaeid also occurs in the boreal Ossipee Pine Barrens in New Hampshire; in several midlatitude inland pine barrens, including the degraded barrens at Concord, NH, New York's Albany Pine Bush, and the Montague sand plains in Massachusetts; near the Arcadia Management Area, a coastal pine barrens in Rhode Island; and in the New Jersey Pine Barrens. The only Pennsylvania record was from pitch pine in the Nottingham Park serpentine barrens.

Despite its wide range in the Northeast, *E. depressus* is patchily distributed, often occurring in edaphic "islands" that differ from surrounding areas in having nutrient-poor, excessively drained soil and generally higher fire frequency. At Fryeburg, ME, Concord, NH, and Albany, NY, it was a species of "urban forests" (e.g. McBride and Jacobs 1976), occurring on remnant pitch pines amid commercial development and suburban sprawl.

This pine seed specialist may have been widespread in the Northeast before the Pleistocene glaciations. During the glacial period, jack pine (*P. banksiana* Lamb.) and pitch pine survived in refugia along the Atlantic coastal plain east and south of the ice sheets (see Slater et al. 1993). It is likely that *E. depressus* also survived in such glacial refugia. When the climate warmed, this lygaeid migrated northward along the coastal plain, following the slow migration of pitch pine into once-glaciated areas. Pine barrens apparently reached their maximum during the Hypsithermal Interval, about 8,000 years before present, when the climate was much drier and warmer. With a return to wetter, cooler conditions, the extent of pitch pine-scrub oak barrens was reduced; some of these once-continuous communities became isolated (Cryan 1985). In addition, land development, fire suppression, and other types of anthropogenic influences have adversely affected pine barrens and likely have further fragmented the range of *E. depressus* on pitch pine in the Northeast.

Some cones of both pitch pine and jack pine are serotinous, remaining closed after maturity until exposed to high temperature. This polymorphism is an adaptation to fire in disclimax communities, allowing seed to be shed under conditions most favorable for regeneration (Ledig and Little 1979). Slater et al. (1993) speculated that cone serotiny may have promoted the arboreal niche of another pine-restricted rhyparochromine, *Slaterobius quadristriatus* (Barber), by extending seed retention. *Eremocoris depressus,* however, develops in the Northeast on pitch pines bearing nonserotinous or open cones.

The rarely collected *S. quadristriatus* uses pitch pine as its host in the New Jersey Pine Barrens, but it develops on jack pine in the Great Lakes region (Slater et al. 1993). A similar pattern of host use may also prevail in another seldom-collected pine cone specialist, the cerambycid *Xylotrechus schaefferi* Schott (Hoebeke and Huether 1990). My attempts to collect *E. depressus* on jack pine have been unsuccessful: in Clinton County, NY, near known populations of this bug on pitch pine, as well as in Michigan and Minnesota. Because of this lygaeid's spotty distribution and the difficulty of detecting populations in cones, more intensive sampling may eventually result in its collection from jack pine.

In the southern states, *E. depressus* is associated with several economically important pine species. This lygaeid can be added to the small number of heteropterans known to feed on mature seeds of North American pines. The importance of rhyparochromines as predators of seeds on plants and of fallen seeds in the litter layer is generally underestimated because their feeding does not produce dramatic symptoms; they make nearly invisible holes in seeds (Sweet 1964, 1977). Yet, among heteropterans that feed on pine seeds, any importance of *E. depressus* in seed orchards of the South is pre-

sumably much less than that of the scutellerid *Tetyra bipunctata* (Herrich-Schaeffer) or species belonging to the coreid genus *Leptoglossus* (see Hedlin et al. 1981).

Eremocoris depressus differs from nearly all other rhyparochromine lygaeids not only in its arboreal habits but also its restriction to a single plant genus (Sweet 1964). Even though nymphs develop only on pines, adults are occasionally observed on other plants (Barber 1928, USNM collection), perhaps the result of posthibernation dispersal (Sweet 1964). Within *Eremocoris,* arboreal habits and the flattened body form are certainly derived characters; a similar example in the Rhyparochrominae (Ozophorini) is *Ozophora hohenbergia* Slater & Baranowski, a dorsoventrally flattened, arboreal member of an otherwise litter-inhabiting genus (Slater and Baranowski 1978). Nearly all other North American species of *Eremocoris* are litter inhabitants that show a preference for conifer seeds (Sweet 1964, 1977). But *Eremocoris cupressicola* Ashlock lives in cypress trees in California, apparently feeding on seeds in open cones (Ashlock 1979). Unlike the brachypterous *E. cupressicola, E. depressus* is macropterous. Selection tends to favor flight capability in arboreal Hemiptera because of the architectural complexity or three dimensionality of the habitat (Slater 1977, Waloff 1983, Denno 1994, Schuh and Slater 1995). Flight would also seem advantageous in fire disclimax communities such as pitch pine-scrub oak barrens.

Eremocoris depressus is further atypical of most other New England rhyparochromines in its seasonality. Adults of this univoltine species appear late in the season, usually not until mid-August or early September. Although details of the seasonal history remain unknown, *E. depressus* most closely resembles *Scolopostethus atlanticus* Horvath in its seasonality. In the New England fauna, *S. atlanticus* is also a late-maturing, univoltine species whose nymphal development is prolonged over most of the summer (Sweet 1964).

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